Fluids and Combustion Facility ISS Requirement Compliance Matrix

Fluids and Combustion Facility

Preliminary
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AUTHORIZED by CM when under FORMAL Configuration Control	
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PREFACE

The National Aeronautics and Space Administration (NASA) is developing a modular, multi-user experimentation facility for conducting fluid physics and combustion science experiments in the microgravity environment of the International Space Station (ISS). This facility, called the Fluids and Combustion Facility (FCF), consists of three test platforms: the Fluids Integrated Rack (FIR), the Combustion Integrated Rack (CIR), and the Shared Accommodations Rack (SAR). This document gives the requirement compliance of the FCF Racks per the requirements listed in ISS 57000. This document reference other supporting documents which give detailed compliance to science, ISS, and safety requirements. Compliance to engineering requirements are addressed in this document with references to supporting design documentation.

ISS REQUIREMENT COMPLIANCE MATRIX
FLUIDS AND COMBUSTION FACILITY

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REVISION PAGE
ISS REQUIREMENT COMPLIANCE MATRIX

Revision	Date	Description of Change or ECO's/ECP's Incorporated	Verification and Date
Preliminary	10/18/00	Initial	10/23/00

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1.0 INTRODUCTION

1.1 Purpose.

The purpose of this document is to show the Fluids and Combustion Facility (FCF) compliance to the contractual requirements as specified in SSP 57000 as called out in FCF-SPEC-0001, Rev. 5.1.

1.2 Scope.

The scope of this document gives the current top-level overview of the compliance to the requirements listed in SSP 57000. The table in paragraph 3.0 lists each requirement and the current state of compliance. Appropriate documents are reference where detailed compliance (or non-compliance) is given. Detailed responses to engineering requirements not in compliance are listed in this document, unless supporting documentation is cited that can explain the non-compliance in greater detail.

2.0 DOCUMENTS

This section lists specifications, models, standards, guidelines, handbooks, and other special publications. These documents have been grouped into two categories: applicable documents and reference documents.

2.1 Order of precedence for documents.

In the event of a conflict between this document and other documents referenced herein, the requirements of this document shall apply. In the event of a conflict between this document and the contract, the contractual requirements shall take precedence over this document. All documents used, applicable or referenced, are to be the issues defined in the Configuration Management (CM) contract baseline. All document changes, issued after baseline establishment, shall be reviewed for impact on scope of work. If a change to an applicable document is determined to be effective, and contractually approved for implementation, the revision status will be updated in the CM contract baseline. The contract revision status of all applicable documents is available by accessing the CM database. Nothing in this document supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.2 Applicable documents.

The documents in these paragraphs are applicable to the FCF Project to the extent specified herein.

FCF-SPEC-0001 Draft, Rev. 5.1 6/21/99	System Specification – Fluids and Combustion Facility
FCF-SPC-0001 Final, Rev. 6.0 10/11/00	System Specification – Fluids and Combustion Facility
SSP 57000	Pressurized Payloads Interface Requirements Document

2.3 Reference documents.

The documents in this paragraph are provided only as reference material for background information and are not imposed as requirements.

3.0 REQUIREMENT COMPLIANCE PHILOSOPHY

The matrix presented in paragraph 3.1 gives the current status of the CIR, FIR and SAR compliance to SSP 57000. ISS compliance is at the rack level since that is the interface that ISS will process, launch and integrate on orbit. Requirements compliance is a dynamic process covering science, ISS, and project requirements as they are disseminated from the contract documentation to the Flight and/or Ground Segment levels to the rack level, to individual assemblies, and in some cases, individual components. Requirements compliance constantly changes at all levels during the development and testing phase of a project toward the completion of the flight hardware design. Because of the staggered deployment sequence of the FCF System, the design fidelity varies.

The FCF System specification upgrade, Prime Item Specification upgrades, and requirement flow down to assemblies took place concurrently due to the extremely tight schedule. Because of the large number of requirements and the complexity of the flow down to lower levels, the Dynamic Object Orient Requirements System (DOORS) software was purchased. This program allows for traceability to requirements among multiple documents and allows for customization to accommodate detailed compliance descriptions. The database is in development and it is hoped that it will be partially operational by the Preliminary Design Review (PDR). The database will be accessible from the web with two review only accounts for government use.

This document is an attempt to provide the current compliance status of the FCF racks (CIR, FIR and SAR) and will be replaced by the DOORS database. Due to the large number and complexity of requirements several accompanying documents tabletop reviews and PDR presentations will be referenced which show detailed compliance or give detailed explanations for non-compliance. This document will cover top-level compliance. The word “Comply” will be used to show a requirement in compliance based on current design information and strategy. The phrase “Will Comply (WC) ” will be used to show that a requirement is not yet in compliance, but is expected to be compliant to the requirement when sufficient analysis, and/or tests confirm compliance. Brief descriptions where detailed information can be found will be provided. The phrase “Does Not Comply (NC) ” will be used to show where the FCF System will fall short of meeting the requirement. The term “NA” indicates a heading or a requirement that is not applicable. Depending on the requirement a reference may be cited or a brief explanation given as to the mitigation strategy to become compliant. All the compliance descriptions and supporting compliance information will be incorporated and/or referenced in DOORS.

TABLE I. FCF ISS Compliance Matrix

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
SSP 57000						
Payload Interface Requirements and Guidance	3	NA	Heading	Heading	Heading	
Structural/Mechanical, and Microgravity and Stowage Requirements	3.1	NA	Heading	Heading	Heading	
Structural/Mechanical	3.1.1	NA	Heading	Heading	Heading	
GSE Interfaces	3.1.1.1a	3.2.7.4	C	C	C	Racks are supplied by Boeing. FCF does not modify the outside of the rack and there are no protrusions or modifications to effect this.
	3.1.1.1b		C	C	C	Racks are supplied by Boeing. FCF does not modify the outside of the rack and there are no protrusions or modifications to effect this.
	3.1.1.1c		C	C	C	Racks are supplied by Boeing. FCF does not modify the outside of the rack and there are no protrusions or modifications to effect this.
	3.1.1.1d		C	C	C	Racks will be shipped in air ride trucks and will be equiped with acceleration trip indicators. Shipping Plan is TBD.
MPLM Interfaces	3.1.1.2a	3.2.7.4	C	C	C	Racks are supplied by Boeing. FCF does not modify the outside of the rack and there are no protrusions or modifications to effect this.
	3.1.1.2b		C	C	C	Racks are supplied by Boeing. Although one of the three relief valves will be removed the open surface area for ARIS equipment more than compensates for the lost area. Formal analysis will be conducted.
Deleted	3.1.1.2c	NA	NA	NA	NA	
Deleted	3.1.1.2d	NA	NA	NA	NA	

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
	3.1.1.2e		C	C	C	Racks are supplied by Boeing. FCF does not modify the outside of the rack and there are no protrusions or modifications to effect this.
MPLM Late/Early Access Requirements	3.1.1.2.1	NA	NA	NA	NA	
MPLM Late Access Envelope (KSC)	3.1.1.2.1.1	NA	NA	NA	NA	
MPLM Early Access Envelopes (KSC and DFRC)	3.1.1.2.1.2	NA	NA	NA	NA	
Loads Requirements	3.1.1.3a	3.3.11.2	C	C	C	Preliminary Analysis of launch/landing loads demostrates positive margins of safety for the racks and FCF hardware. Boeing will perform analysis for CIR rack.
		3.3.11.3	C	C	C	
		3.3.11.4	C	C	C	
	3.1.1.3b		NC	C	C	Preliminary Analysis of on orbit loads demostrates positive margins of safety for the racks and FCF hardware. The ARIS snubber is the only acception and is being worked.
	3.1.1.3c		C	C	C	It is planned to have the RUP umbilicals restrained during launch. Capability has been provided.See B specs.
	3.1.1.3d		C	C	C	Preliminary Analysis of crew induced loads demostrates positive margins of safety for the racks and FCF hardware.
	3.1.1.3e		C	C	C	Preliminary Analysis of launch/landing vibration loads demostrates positive margins of safety for the FCF hardware mounted to ISPR rack posts. The safety critical structures data package and the design analysis report (for the chamber) from CIR PDR addresses some of these items.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
	3.1.1.3.f		C	C	C	Preliminary Analysis of launch/landing loads demostrates positive margins of safety for the racks and FCF hardware.The safety critical structures data package and the design analysis report (for the chamber) from CIR PDR addresses some of these items.
Rack Requirements	3.1.1.4a		C	C	C	Currently there is an exception in the system for the CIR to exceed this value up to 1100 kg. The FIR and SAR are below this value. See Mass Properties Report.
	3.1.1.4b		C	C	C	Equipment is being designed to maintain positive margins of safety for on-orbit depress/repress rates. Most components are air cooled and therefore are adequately vented. The EPCU is the exception.
	3.1.1.4c		NC	C	C	Preliminary analysis of the intergrated racks and knee brace show acceptable modal frequencies. The CIR has a known issue with this which is being worked.
	3.1.1.4d		NC	C	C	Preliminary analysis of the equipment mounted to the rack show acceptable modal frequencies. The CIR optics bench has a known issue which is being worked.
	3.1.1.4e		C	C	C	Currently all areas where keep out zones are violated an exception is being processed.
	3.1.1.4f		C	C	C	
Deleted	3.1.1.4g		NA	NA	NA	
Deleted	3.1.1.4h		NA	NA	NA	
	3.1.1.4i		C	C	C	Racks are supplied by Boeing. FCF does not modify the outside of the rack and there are no protrusions or modifications to effect this.
Deleted	3.1.1.4j		NA	NA	NA	
	3.1.1.4k		C	C	C	Preliminary analysis of the intergrated racks show acceptable margins when exposed to PFE discharge.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
	3.1.1.4l		C	C	C	Racks are supplied by Boeing. FCF does not modify the outside of the rack and there are no protrusions or modifications to effect this.
	3.1.1.4m		C	C	C	Current rack design has no pressure relief devices on the front. See assembly drawings.
Lab Window Rack Location Requirements	3.1.1.4.1		NA	NA	NA	
Safety Critical Structures Requirements	3.1.1.5a		C	C	C	Racks are being designed in accordance with SSP 52005. See Fracture Control Plan (FCF-PLAN-0030). See Safety Critical Structures data Package.
Deleted	3.1.1.5b		NA	NA	NA	
Deleted	3.1.1.5c		NA	NA	NA	
Deleted	3.1.1.5d		NA	NA	NA	
Connector and Umbilical Physical Mate	3.1.1.6	NA	Heading	Heading	Heading	
Connector Physical Mate	3.1.1.6.1		C	C	C	Interfaces to the UIP, UOP and Fluid services are compatible. Mating connectors have been purchased or are on order from suppliers to Boeing.
Umbilical Physical Mate	3.1.1.6.2		C	C	C	??
On-Orbit Payload Protrusions	3.1.1.7	3.2.2.1	C	C	C	All protrusions have been identified and provided to ISS. The rack doors and the optics bench.
On-Orbit Permanent Protrusions	3.1.1.7.1		C	C	C	There are no permanent protrusions on FCF.
On-Orbit Semi-Permanent Protrusions	3.1.1.7.2a-c		C	C	C	There are no semi- permanent protrusions on FCF.
On-Orbit Temporary Protrusions	3.1.1.7.3a,b		C	C	C	All temporary protrusions have been identified and provided to ISS. The rack doors and the optics bench. For the CIR it is in the ICD SSP 57217. For the FIR it is in exception 57218-NA-0001.
On-Orbit Momentary Protrusions	3.1.1.7.4		C	C	C	There are no momentary protrusions on FCF.
On-Orbit Protrusions for Keep Alive Operations	3.1.1.7.5a,b		NA	NA	NA	

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Microgravity	3.1.2	NA	Heading	Heading	Heading	
Quasi-steady Requirements	3.1.2.1a		C	C	C	The integrated racks are being assessed for Microgravity disturbance in accordance with the Microgravity Control Plan (FCF-PLN-037). Testing will be conducted to support the analysis.
	3.1.2.1b		C	C	C	The integrated racks are being assessed for Microgravity disturbance in accordance with the Microgravity Control Plan (FCF-PLN-037). Testing will be conducted to support the analysis.
Vibratory Requirements	3.1.2.2a	3.2.4.8	C	C	C	The integrated racks are being assessed for Microgravity disturbance in accordance with the Microgravity Control Plan (FCF-PLN-037). Testing will be conducted to support the analysis.
	3.1.2.2.b		C	C	C	The integrated racks are being assessed for Microgravity disturbance in accordance with the Microgravity Control Plan (FCF-PLN-037). Testing will be conducted to support the analysis.
Transient Requirements	3.1.2.3a		C	C	C	The integrated racks are being assessed for Microgravity disturbance in accordance with the Microgravity Control Plan (FCF-PLN-037). Testing will be conducted to support the analysis.
	3.1.2.3b		C	C	C	The integrated racks are being assessed for Microgravity disturbance in accordance with the Microgravity Control Plan (FCF-PLN-037). Testing will be conducted to support the analysis.
Microgravity Environment	3.1.2.4	NA	Information	Information	Information	
ARIS Interfaces	3.1.2.5	NA	Heading	Heading	Heading	
Stowage	3.1.3	NA	C	C	C	The document sited is not a requirements document. All of our stowage currently is envisioned to fit in the standard packaging options.
Electrical Requirements	3.2		Heading	Heading	Heading	
Electrical Power Characteristics	3.2.1	NA	Information	Information	Information	

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Steady-State Voltage Characteristics	3.2.1.1	NA	Heading	Heading	Heading	
Interface B	3.2.1.1.1		C	C	C	EPCU is designed to meet this requirement (GFE). See EPCU EM test results. Payloads using 120 V responsible for meeting this.
Interface C	3.2.1.1.2		NA	NA	NA	
Ripple Voltage Characteristics	3.2.1.2		Heading	Heading	Heading	
Ripple Voltage and Noise	3.2.1.2.1		C	C	C	EPCU is designed to meet this requirement (GFE). FCF hardware is designed to meet the EPCU ripple and noise specification.See EPCU EM test results. Payloads using 120 V responsible for meeting this.
Ripple Voltage Spectrum	3.2.1.2.2		C	C	C	EPCU is designed to meet this requirement (GFE). FCF hardware is designed to meet the EPCU ripple voltage requirments. See EPCU EM test results. Payloads using 120 V responsible for meeting this.
Transient Voltages	3.2.1.3		Heading	Heading	Heading	
Interface B	3.2.1.3.1		C	C	C	EPCU is designed to meet this requirement (GFE). FCF hardware is designed to meet the EPCU ripple and noise specification.See EPCU EM test results. Payloads using 120 V responsible for meeting this.
Interface C	3.2.1.3.2		NA	NA	NA	
Fault Clearing and Protection	3.2.1.3.3		C	C	C	EPCU is designed to meet this requirement (GFE).See EPCU EM test results.
Non-Nominal Voltage Range	3.2.1.3.4a		C	C	C	EPCU is designed to meet this requirement (GFE).See EPCU EM test results. Payloads using 120 V responsible for meeting this.
	3.2.1.3.4b		C	C	C	EPCU is designed to meet this requirement (GFE).See EPCU EM test results. Payloads using 120 V responsible for meeting this.
Delete	3.2.1.4		NA	NA	NA	
Electrical Power Interface	3.2.2		Heading	Heading	Heading	
UIP and UOP Connectors and Pin Assignments	3.2.2.1a-c		C	C	C	See PDR provided drawings.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Power Bus Isolation	3.2.2.2a		C	C	C	EPCU is designed to meet this requirement (GFE).See EPCU EM test results.
	3.2.2.2b		C	C	C	EPCU is designed to meet this requirement (GFE).See EPCU EM test results.
Compatibility with Soft Start/Stop RPC	3.2.2.3		C	C	C	EPCU is designed to meet this requirement (GFE).Payloads using 120 V responsible for meeting this.
Surge Current	3.2.2.4		C	C	C	EPCU is designed to meet this requirement (GFE). EPCU will be operated by the IOP so as not to violate this requirement. See power profiles provided.Payloads using 120 V responsible for meeting this.
Reverse Energy/Current	3.2.2.5		C	C	C	EPCU is designed to meet this requirement (GFE).See EPCU EM test results.
Circuit Protection Devices	3.2.2.6		Heading	Heading	Heading	
ISS EPS Circuit Protection Characteristics	3.2.2.6.1.		Heading	Heading	Heading	
Remote Power Controllers (RPCs)	3.2.2.6.1.1a		C	C	C	EPCU is designed to meet this requirement (GFE).See EPCU EM test results.See power profiles.
	3.2.2.6.1.1b		NA	NA	NA	
	3.2.2.6.1.1c		NA	NA	NA	
	3.2.2.6.1.1d		C	C	C	EPCU is designed to meet this requirement (GFE). See EPCU EM test results. Internal wire derating will be part of C-specs.
	3.2.2.6.1.1e		C	C	C	EPCU is designed to meet this requirement (GFE).See EPCU EM test results. Internal wire derating will be part of C-specs.
EPCE RPC Interface Requirements	3.2.2.6.2		Heading	Heading	Heading	
RPC Trip Coordination	3.2.2.6.2.1		Heading	Heading	Heading	
Payload Trip Ratings	3.2.2.6.2.1.1		C	C	C	EPCU is designed to meet this requirement (GFE).See EPCU EM test results.
Deleted	3.2.2.6.2.1.2		NA	NA	NA	

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
EPCE Complex Load Impedances	3.2.2.7		Heading	Heading	Heading	
Interface B	3.2.2.7.1a-b		C	C	C	EPCU is designed to meet this requirement (GFE). See EPCU EM test results.FCF hardware will be analysed to verify that load impedance does not exceed boundary.Payloads using 120 V responsible for meeting this.
Interface C	3.2.2.7.2		NA	NA	NA	
Large Signal Stability	3.2.2.8		C	C	C	EPCU is designed to meet this requirement (GFE).See EPCU EM test results.Payloads using 120 V responsible for meeting this.
Maximum Ripple Voltage Emissions	3.2.2.9		C	C	C	EPCU is designed to meet this requirement (GFE).See EPCU EM test results. Payloads using 120 V responsible for meeting this.
Electrical Load Stand-Alone Stability	3.2.2.10a-c		C	C	C	EPCU is designed to meet this requirement (GFE).See EPCU EM test results. See Electromagnetic Interferance/compatibility Plan (FCF-PLN-0027)
Electrical Power Consumer Constraints	3.2.3		Heading	Heading	Heading	
Wire Derating	3.2.3.1a		NA	NA	NA	Cable is provided by ARIS.
	3.2.3.1b		C	C	C	EPCU is designed to meet this requirement (GFE). See EPCU EM test results.Down stream wiring is in accordance with TM 102179, see CIR and FIR Phase I safety data packages for details.
	3.2.3.1c		C	C	C	Cable is provided by ARIS.
Exclusive Power Feeds	3.2.3.2a		C	C	C	Power is only received for the UIP and EPCU is designed to receive power only from the UIP. See PDR Drawings.
	3.2.3.2b		C	C	C	Cabeling between Interface C and Interface B is not designed into the system. See system schematics and block diagrams provided in PDR package.
Loss of Power	3.2.3.3		C	C	C	Safe conditions in the event of loss of power has been analyzed as part of the CIR and FIR Phase I safety data packages.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Electromagnetic Compatibility	3.2.4	3.3.2	C	C	C	EPCU is designed to meet this requirement (GFE). See EPCU EM test results.Components are being chosen to meet the requirement. Testing will be performed on EM.See Electromagnetic Interferance/compatibility Plan (FCF-PLN-0027).
Electrical Grounding	3.2.4.1		C	C	C	EPCU is designed to meet this requirement (GFE).See EPCU EM test results.
Electrical Bonding	3.2.4.2		C	C	C	EPCU is designed to meet this requirement (GFE). See EPCU EM test results.The rack is designed to interface with the module bond strap.
Cable/Wire Design and Control Requirements	3.2.4.3		C	C	C	Cable is provided by ARIS.
Electromagnetic Interference	3.2.4.4		C	C	C	EPCU is designed to meet this requirement (GFE). See EPCU EM test results.It will be tested along with the integrated rack. See EMI Interference/Compatibility Plan (FCF-PLN-0027).
Electrostatic Discharge	3.2.4.5	3.3.2	C	C	C	EPCU is designed to meet this requirement (GFE). Assembly drawings will call this out.
Alternating Current (AC) Magnetic Fields	3.2.4.6		C	C	C	Currently there are no ac magnetic fields expected in the design.
Direct Current (DC) Magnetic Fields	3.2.4.7		C	C	C	Part of EMI test. See Electromagnetic Interferance/compatibility Plan (FCF-PLN-0027)
Corona	3.2.4.8		NA	NA	NA	
Lightning	3.2.4.9		NA	NA	NA	Hardware is not connected and is off during launch phase.
EMI Susceptibility for Safety-Critical Circuits	3.2.4.10		NA	NA	NA	
Safety	3.2.5		Heading	Heading	Heading	
Payload Electrical Safety	3.2.5.1		Heading	Heading	Heading	
Mating/Demating of Powered Connectors	3.2.5.1.1		C	C	C	FCF provides a number of upstream inhibits for connector mating/demating, the RPC controlled by the RMS and the EPCU controlled by the rack cut off switch. See CIR and FIR Phase I safety data packages.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Safety-Critical Circuits Redundancy	3.2.5.1.2		C	C	C	EPCU is designed to meet this requirement (GFE).See EPCU EM test results.See CIR and FIR Phase I safety data packages
Rack Maintenance Switch (Rack Power Switch)	3.2.5.2		C	C	C	This switch is supplied as part of the rack. The design incorporates it, See CIR and FIR Phase I safety data packages.
Power Switches/Controls	3.2.5.3a-c		C	C	C	EPCU is designed to meet this requirement (GFE).See EPCU EM test results. EPCU shut off switch is in PDR drawings.
Ground Fault Circuit Interrupters (GFCI)/Portable Equipment DC sourcing Voltage	3.2.5.4a-g		NA	NA	NA	
Portable Equipment/Power Cords	3.2.5.5a-b		NA	NA	NA	
Deleted	3.2.5.6		NA	NA	NA	
MPLM (CIR, FIR, SAR Not Powered in MPLM)	3.2.6		NA	NA	NA	
Command and Data Handling Interface Requirements	3.3		Heading	Heading	Heading	
General Requirements	3.3.1		Information	Information	Information	
Word/Byte Notations, Types and Data Transmissions	3.3.2		Information	Information	Information	
Word/Byte Notations	3.3.2.1		C	C	C	IOP is designed to meet the requirement for word/byte notations.
Data Types	3.3.2.2		C	C	C	IOP is designed to meet the requirement for data types.
Data Transmissions	3.3.2.3a-c		C	C	C	IOP is designed to meet the requirement for data transmission order.
Deleted	3.3.3		C	C	NA	

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Consultative Committee for Space Data Systems	3.3.4		C	C	C	IOP is designed to use the CCSDS Data Packets.
CCSDS Data	3.3.4.1a-c		C	C	C	IOP is designed to use the CCSDS Data Packets.
CCSDS Data Packets	3.3.4.1.1		C	C	C	Intgrated rack data packets are being developed in accordance with the requirments
CCSDS Primary Header	3.3.4.2.1.1		C	C	C	??
CCSDS Secondary Header	3.3.4.2.1.2		C	C	C	??
CCSDS Data Field	3.3.4.2.2		C	C	C	??
CCSDS Data Bitstream	3.3.4.2.3		C	C	C	
CCSDS Application process Identification Field	3.3.4.2.4		C	C	C	
CCSDS Time Codes	3.3.4.3		Heading	Heading	Heading	
CCSDS Unsegmented Time	3.3.4.3.1		C	C	C	
CCSDS Segmented Time	3.3.4.3.2		C	C	C	
MIL-STD-1553B Low Data Rate Link (LRDL)	3.3.5		C	C	C	The IOP is designed to implement a single MIL STD 1553B RT to the bus.
MIL-STD-1553B Protocol	3.3.5.1		Heading	Heading	Heading	
Standard Messages	3.3.5.1.1		C	C	C	The IOP is designed to implement MIL STD 1553B standard messages.
Commanding	3.3.5.1.2		C	C	C	See CIR and FIR Phase I safety data packages.
Health and Status Data	3.3.5.1.3		C	C	C	The IOP is designed to develop and transmit health and status data.
Safety Data	3.3.5.1.4a-b		C	C	C	The IOP is designed to generate and transmit C&W related parameters as required. See CIR and FIR Phase I safety data packages.
Caution and Warning	3.3.5.1.4.1		C	C	C	The IOP is designed to generate and transmit C&W related parameters as required. See CIR and FIR Phase I safety data packages.
Class 1 - Emergency	3.3.5.1.4.1.1		C	C	C	The Software will comply with the definition and respond accordingly
Class 2 - Warning	3.3.5.1.4.1.2		C	C	C	The Software will comply with the definition and respond accordingly

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Class 3 - Caution	3.3.5.1.4.1.3		C	C	C	The Software will comply with the definition and respond accordingly
Class 4 - Advisory	3.3.5.1.4.1.4		C	C	C	The Software will comply with the definition and respond accordingly
Service Requests	3.3.5.1.5		C	C	C	Service requests will be in accordance with requirements.
Ancillary Data	3.3.5.1.6		C	C	Information	
File Transfer	3.3.5.1.7		C	C	C	File transfer is being implemented as required.
Low Rate Telemetry	3.3.5.1.8		C	C	C	The software specification has included this in its requirements
Defined Mode Codes	3.3.5.1.9		C	C	C	The software specification has included this in its requirements
Implemented Mode Codes	3.3.5.1.10		C	C	C	The software specification has included this in its requirements.
Unimplemented/Undefined Mode Codes	3.3.5.1.11		C	C	C	The software specification has included this in its requirements.
Illegal Commands	3.3.5.1.12		C	C	C	The software specification has included this in its requirements.
MIL-STD-1553B Low Rate Data Link (LRDL) Interface Characteristics	3.3.5.2		Heading	Heading	Heading	
LRDL Remote Terminal Assignment	3.3.5.2.1		Heading	Heading	Heading	
LRDL Connector/Pin Assignments	3.3.5.2.1.1		Heading	Heading	Heading	
MIL-STD-1553B Bus A and B Connector/Pin Assignments	3.3.5.2.1.2a		C	C	C	Drawings have been provided for PDR demostrating this.
	3.3.5.2.1.2b		C	C	C	Drawings have been provided for PDR demostrating this.
	3.3.5.2.1.2c		C	C	C	Drawings have been provided for PDR demostrating this.
Deleted	3.3.5.2.1.3		NA	NA	NA	

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Remote Terminal Hardwired Address Code	3.3.5.2.1.4a-e		C	C	C	Drawings have been provided for PDR demostrating this and the software specification has included this in its requirements.
LRDL Signal Characteristics	3.3.5.2.2		C	C	C	This will be provided at the table top review. Also the spec FCF REQ-0065 contians this information.
LRDL Cabling	3.3.5.2.3		C	C	C	Drawings have been provided for PDR demonstrating this.
Multi-Bus Isolation	3.3.5.2.4		C	C	C	COTS hardware specification meets 1553 requirements.
Medium Rate Data Link (MRDL)	3.3.6	3.7.1.3.2e	NA	NA	NA	
MRDL Protocol	3.3.6.1		C	C	C	COTS hardware specification meets 1553 requirements.
Integrated Rack Protocols on the MRDL	3.3.6.1.1		C	C	C	The software specification has included this in its requirements. See FCF REQ 0065
MRDL Address	3.3.6.1.2		C	C	C	COTS hardware specification meets 1553 requirements.
ISPR MRDL Connectivity	3.3.6.1.3a-c		C	C	C	Drawings have been provided for PDR demostrating this and the software specification has included this in its requirements.
MRDL connector/Pin Assignments and Wire Requirements	3.3.6.1.4a		C	C	C	Drawings have been provided for PDR demostrating this.
	3.3.6.1.4b		C	C	C	Drawings have been provided for PDR demostrating this.
	3.3.6.1.4c		C	C	C	Drawings have been provided for PDR demostrating this.
	3.3.6.1.4d		C	C	C	Drawings have been provided for PDR demostrating this.
Deleted	3.3.6.1.4.1		NA	NA	NA	
Deleted			NA	NA	NA	
MRDL Signal Characteristics	3.3.6.1.5		C	C	C	COTS hardware specification meets requirements.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
MRDL Cable Characteristics	3.3.6.1.6		C	C	C	Drawings have been provided for PDR demostrating this.
Insertion Loss	3.3.6.1.6.1		C	C	C	Must be tested in future.
Differential Characteristics Impedance	3.3.6.1.6.2		C	C	C	Drawings have been provided for PDR demostrating this.
Medium Timing Jitter	3.3.6.1.6.3		C	C	C	COTS hardware specification meets requirements and drawings have been provided.
High Rate Data Link (HRDL)	3.3.7	3.7.1.3.2i	Heading	Heading	Heading	
Payload to High Frame Rate Multiplexer (HRFM) Protocols	3.3.7.1		C	C	C	
HRDL Interface Characteristics	3.3.7.2		Heading	NA	Heading	
Physical Signaling	3.3.7.2.1		C	C	C	COTS hardware specification meets requirements or Boeing supplied board.
Physical Signaling Data Rates	3.3.7.2.1.1a -c		C	C	C	The software specification has included this in its requirements.
Encoding	3.3.7.2.2		C	C	C	COTS hardware specification meets requirements or Boeing supplied board.
Symbols Used in Testing	3.3.7.2.3		C	C	C	The software specification has included this in its requirements.
Integrated Rack HRDL Optical Power	3.3.7.3		Heading	Heading	Heading	
Integrated Rack HRDL Transmitted Optical Power	3.3.7.3.1		C	C	C	Testing scheduled for July 01.
Integrated Rack HRDL Received Optical Power	3.3.7.3.2		NA	NA	NA	
HRDL Fiber Optic Cable	3.3.7.4		C	C	C	Drawings have been provided for PDR demostrating this.
HRDL Fiber Optic Cable Bend Radius	3.3.7.5		C	C	C	Assembly procedures to be created to insure application.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
HRDL Connectors and Fiber	3.3.7.6a		NA	NA	NA	
	3.3.7.6b		NA	NA	NA	
	3.3.7.6c		NA	NA	NA	
	3.3.7.6d		C	C	C	Drawings have been provided for PDR demostrating this.
Deleted	3.3.7.7		NA	NA	NA	
Personal Computers	3.3.8		NA	NA	NA	
Payload Laptop (Not Used)	3.3.8.1		NA	NA	NA	
PSC (Not Used)	3.3.8.2		NA	NA	NA	
SSC	3.3.8.3	3.7.1.3.5e	C	C	C	Drawings have been provided for PDR demostrating this.
UOP	3.3.9		NA	NA	NA	
Maintenance Switch, Smoke Detector, Smoke Indicator, and Integrated Rack Fan Interfaces	3.3.10		Heading	Heading	Heading	
Rack Maintenance Switch (Rack Power Switch) Interfaces	3.3.10.1a-b		NA	NA	NA	Boeing provided hardware. See PDR drawings.
Smoke Detector Interfaces	3.3.10.2		C	C	C	See PDR drawings
Analog Interface Characteristics	3.3.10.2.1		C	C	C	Boeing smoke detector. See drawings for proper application.
Discrete Command Built-in-Test- Interface Characteristics	3.3.10.2.2		C	C	C	Boeing smoke detector. See drawings for proper application.
Smoke Indicator Electrical Interfaces	3.3.10.2.3		C	C	C	The smoke detector is provided by the approved supplier (Boeing) and will be implemented per the requirements RMSA contains the indicator. See electrical interface schematics.
Fan Ventilation Status Electrical Interfaces	3.3.10.2.4		C	C	C	The fan (ATCU) which provides ventilation for the smoke detector electrical interface characteristics will be provided in accordance with requirements.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Rack maintenance Switch (Rack Power Switch)/ Fire Detection Support Interface Connector	3.3.10.3a-c		NA	NA	C	The rack power switch/fire detection interface connectors mating will be in accordance with requirments. See electrical schematics.
Payload NTSC video and audio Interface Requirements	3.4		NA	NA	NA	
Payload NTSC Video Interface Requirements	3.4.1		Heading	Heading	Heading	
Payload NTSC Video Characteristics	3.4.1.1a-c		C	C	C	The rack NTSC Video interface will be in accordance with the requirements. See electrical schematics.
NTSC Fiber Optic Video	3.4.1.2		Heading	Heading	Heading	
Pulse Frequency Modulation NTSC Fiber Optic Video Characteristics	3.4.1.2.1a-b		C	C	C	The pulse frequency modulation for the fiber optical video interface will be in accordance with the requirements. See table top review.
Integrated Rack NTSC PFM Video Transmitted Optical Power	3.4.1.2.2		C	C	C	The optical power fiber for the optical video interface will be in accordance with the requirements. See table top review.
Integrated Rack NTSC PFM Video and Sync Signal Received Optical Power	3.4.1.2.3		NA	NA	NA	
Fiber Optic Cable Characteristics	3.4.1.2.4		C	C	C	The cable for the optical video interface will be in accordance with the requirements. See table top review.
PFM NTSC Video Fiber Optic Cable Bend Radius	3.4.1.2.5		C	C	C	A minimum bend radius of 2 inches or greater will be maintained.
Deleted	3.4.1.2.6		NA	NA	NA	
PFM Optical Connector/Pin Assignments	3.4.1.2.7a		NA	NA	NA	

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
	3.4.1.2.7b		NA	NA	NA	
	3.4.1.2.7c		NA	NA	NA	
NTSC Electrical Video Interfaces (Not Used by CIR)	3.4.1.3		Heading	Heading	Heading	
NTSC Electrical Connector/Pin Assignments (Not Used by CIR)	3.4.1.4		NA	NA	NA	
US. Element Audio Interface Requirements (Not Used by CIR)	3.4.2		NA	NA	NA	
Thermal Control Interface Requirements	3.5		Heading	Heading	Heading	
Internal Thermal Control System (ITCS) Interface Requirements	3.5.1		Heading	Heading	Heading	
Physical Interface	3.5.1.1a-b		C	C	C	Connectors for the water cooling loop have been procured from the vendor which supplies the mating end for station and are compliant. GSE.
ITCS Fluid Use and Charging	3.5.1.2a		C	C	C	Coolant for the WTCS is supplied by the same vendor as for station. The cooling system will be cleaned and tested before filling. GSE.
	3.5.1.2b		C	C	C	The racks are planned to be launched with coolant in place and the acumulator developed for expansion is being purchased.Combined procurement with MSFC.
ITCS Pressure Drop	3.5.1.3a		C	C	C	The pressure drop has been analyzed in a preliminary analysis and found to meet the requirements. CIR RPT 0098
	3.5.1.3b		NA	NA	NA	
Coolant Flow Rate	3.5.1.4a		C	C	C	The coolant loop flow rate has been analyzed in a preliminary analysis and found to meet the requirements. CIR RPT 0098

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
	3.5.1.4b		C	C	NA	
Coolant Supply Temperature	3.5.1.5a		C	C	C	The coolant supply temperature has been analyzed in a preliminary analysis and found to meet the requirements.
	3.5.1.5b		NA	NA	NA	
Coolant Return Temperature	3.5.1.6a		C	C	C	The coolant supply temperature drop has been analyzed in a preliminary analysis and found to meet the requirements. CIR RPT 0098
	3.5.1.6b		C	C	C	The coolant supply flow rate for operational modes of less than 1025 watts has been analyzed in a preliminary analysis and found to meet the requirements. CIR RPT 0098
	3.5.1.6c		C	C	C	The coolant return temperature has been analyzed in a preliminary analysis and found to meet the requirements. CIR RPT 0098
	3.5.1.6d		NA	NA	NA	
Coolant Maximum Design Pressure	3.5.1.7a		C	C	C	An analysis has been conducted on the WTCS and it has been found to meet the maximum design pressure with adequate margins.
	3.5.1.7b		NA	NA	NA	
	3.5.1.7c		NA	NA	NA	
Fail Safe Design	3.5.1.8		C	C	C	The integrated racks have been assessed for fail safe design after loss of cooling in any mode of operations. See FIR and CIR Phase I SDP.
Leakage	3.5.1.9a		C	C	C	The system has been analysed for leakage based on vendor data and determined to have a leak rate compliant with the requirements. CIR RPT 0098
	3.5.1.9b		NA	NA	NA	
Quick-Disconnect Air Inclusion	3.5.1.10		C	C	C	QD vendor data has been assessed to meet the requirements of air inclusion and have been determined to be acceptable.
Rack Front Surface Temperature	3.5.1.11		C	C	C	Preliminary thermal analysis have determined that the average front surface temperature of the rack and partial limit are not exceeded.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Cabin Air Heat Leak	3.5.1.12		C	C	C	Preliminary thermal analysis have determined that the sensible heat leak to the cabin air is within the limits specified. See table top review information.
MPLM Cabin Air Cooling	3.5.1.13		NA	NA	NA	
Simultaneous Cooling	3.5.1.14		NA	NA	NA	
Control System Time Constant	3.5.1.15		C	C	C	The WTCS has been assessed for the flow rate change time constant and has been found acceptable. See table top review information. GFE item.
Payload Coolant Quantity	3.5.1.16		C	C	C	The WTCS has been assessed for the maximum required volume of coolant and has been found acceptable. See table top review information. CIR RPT 0098
Payload Gas Inclusion	3.5.1.17		C	C	C	The WTCS has been assessed for the maximum air inclusion due to all components and found acceptable. Vendor drawings meet requirment. Table top review information.
Vacuum System Requirements	3.6		Heading	Heading	Heading	
Vacuum Exhaust System/Waste Gas System (WGS) Requirements	3.6.1	3.8.4.1.7	Heading	Heading	Heading	
VES/WGS Interface	3.6.1.1		C	C	C	The design uses connectors compliant with the requirementsfor the VES/WGS. GFE. Procurement of connectors has been made from the original vendors. See table top reviews.
Input Pressure Limit	3.6.1.2a		C	C	C	For CIR the vent pressure to the vent is controlled to less than 40 psia by three controls described in the CIR Delta Phase I SDP. The control of venting pressure in the FIR and SAR is the responsibility of the payload.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
	3.6.1.2b		C	C	C	For CIR the vent pressure to the vent is controlled to less than 40 psia by three controls described in the CIR Delta Phase I SDP. The control of venting pressure in the FIR and SAR is the responsibility of the payload.
	3.6.1.2c		C	C	C	For CIR the vent pressure to the vent is controlled to less than 40 psia by three controls described in the CIR Delta Phase I SDP. The control of venting pressure in the FIR and SAR is the responsibility of the payload.
Input Temperature Limit	3.6.1.3		C	C	C	For CIR the exhaust gas temperture has been evaluated for the basis experiments and found to be acceptable. For other experments, FIR and SAR experiments it is the responsibility of the payload to verify that gases are vented with in the limits.
Input Dew Point Limit	3.6.1.4		C	C	C	For CIR the exhaust gas dew point will be measured in the CIR with a sensor and venting controlled. For FIR and SAR experiments it is the responsibility of the payload to verify that gases are vented with in the limits.
Acceptable Exhaust Gases	3.6.1.5a		C	C	C	For experiments it is the responsibility of the payload to verify that gases are vented with in the limits.
	3.6.1.5b		C	C	C	It is the responsibility of the payload to verify that gases are vented with in the limits.
	3.6.1.5c		C	C	C	The evaluation of vented gases is the responsibility of the payload.
	3.6.1.5d		C	C	C	For the CIR the FOMA system has a particulate filter which will remove particulates greater than 100 micronmeters. See FOMA table top information. For FIR and SAR the payload is responsible for supplying filters.
Acceptable Gases - List	3.6.1.5.1a		Information	Information	Information	
	3.6.1.5.1b		C	C	NA	
	3.6.1.5.1c		NA	NA	NA	

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
External Contamination Control	3.6.1.5.2		C	C	C	For CIR the FOMA system has been designed to remove some gases that are unacceptable and a program created to evaluate vented gases. The information on the vented gases is the responsibility of the payload. JSC performs the analysis.
Incompatible Gases	3.6.1.5.3a		NA	NA	NA	
	3.6.1.5.3b		NA	NA	NA	
Payload System Access Valve	3.6.1.6					
Vacuum Resource System (VRS)/Vacuum Vent System (VVS) Requirements (Not Used by CIR)	3.6.2		Heading	Heading	Heading	
Input Pressure Limit	3.6.2.2a-b		NA	C	C	It is the responsibility of the payload to verify that gases are vented with in the limits.
Through-put limit	3.6.2.3					It is the responsibility of the payload to verify that gases are vented with in the limits.
Acceptable Gases -	3.6.2.4					It is the responsibility of the payload to verify that gases are vented with in the limits.
Pressurized Gases Interface Requirements	3.7		Heading	Heading	Heading	
Nitrogen Interface Requirements	3.7.1		Heading	Heading	Heading	
Nitrogen Interface Control	3.7.1.1		C	C	C	The CIR FOMA system has the capability to turn on and off the N2 gas flow and control the flow rate. See FOMA schematic at table top review. For FIR and SAR the control of N2 is the responsibility of the payload.
Nitrogen Interface MDP	3.7.1.2		C	C	C	The CIR FOMA system has an MDP of 200 psia and controls the pressure by three means for downstream pressures less than 200 psia. See FOMA schematic at table top review. For FIR and SAR the control of N2 is the responsibility of the payload.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Nitrogen Interface Temperature	3.7.1.3		C	C	C	The CIR FOMA system can tolerate the required temperature range from review of vendor information. See FOMA schematic at table top review. For FIR and SAR the control of N2 is the responsibility of the payload.
Nitrogen Leakage	3.7.1.4		C	C	C	The CIR FOMA system can meet the required leakage rate from review of vendor information. Also some component testing has been done. See FOMA schematic at table top review. For FIR and SAR the control of N2 is the responsibility of the payload.
Nitrogen Physical Interface	3.7.1.5		C	C	C	The nitrogen system connectors are being purchased from the same supplier to the same spec. that provides the ISS end of the QD.
Argon Interface Control (Not Used by CIR)	3.7.2.1		NA	NA	NA	
Carbon Dioxide Interface Requirements (Not Used by CIR)	3.7.3		NA	NA	NA	
Helium Interface Requirements (Not Used by CIR)	3.7.4		NA	NA	NA	
Pressurized Gas Systems	3.7.5		NA	NA	NA	
Manual Valves	3.7.6		NA	NA	NA	
Payload Support Services Interfaces Requirements (Not Used by CIR)	3.8		Heading	Heading	Heading	
Potable Water	3.8.1		Heading	Heading	Heading	
Fluids System Server	3.8.2		C	C	C	Use of the FSS will be with in the requirements and the system has been designed for proper use of the FSS.
Environmental Interface Requirements	3.9	3.2.1.1.6	Heading	Heading	Heading	
		3.2.6	C	C	C	

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
		3.7.1.3.4	C	C	C	
Atmospheric Requirements	3.9.1		Heading	Heading	Heading	
Pressure	3.9.1.1		C	C	C	The integrated racks will be safe when exposed to the range of ISS pressures. The components are designed to withstand depress, standard material are used in contruction and the system shuts down due to lack of air flow at low pressures.
Temperature	3.9.1.2		C	C	C	The integrated racks will be safe when exposed to the range of ISS temperatures. The components are designed using standard materials. Operation at the extrems of these ranges is not expected.
Humidity	3.9.1.3	3.3.14	C	C	C	The integrate racks have been assessed for dew point and have been found acceptable. See table top review information.
Integrated Rack Use of Cabin Atmosphere	3.9.2		Heading	Heading	Heading	
Active Air Exchange	3.9.2.1a,c		NA	NA	NA	
Oxygen Consumption	3.9.2.2		NA	NA	NA	
Chemical Releases	3.9.2.3		NA	NA	NA	
Radiation Requirements	3.9.3		Heading	Heading	Heading	
Integrated Rack Contained or Generated Ionizing Radiation	3.9.3.1		NA	NA	NA	
Ionizing Radiation Dose	3.9.3.2		C	C	C	Review of materials has determined that the the ionizing radiation dose is not a concern. Electronics are being evaluated.
Single Event Effect (SEE) ionizing Radiation	3.9.3.3		C	C	C	All equipment meets the requirements for 2 failure tolerance in the case of control of a catastrophic event, therefore failure of a single electronic item due to SEE does not cause an unsafe condition. See FIR and CIR phase I SDPs. SEE is being evaluated for electronic devices.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Lab Window Rack Location Radiation Requirements	3.9.3.4		NA	NA	NA	
Additional Environmental Conditions	3.9.4		C	C	C	The environmental conditions have been taken into consideration for all components and the integrated racks. See table top review information.
Fire Protection Interface Requirements	3.10		Heading	Heading	Heading	
Fire Prevention	3.10.1		C	C	C	The integrated racks meet the fire prevention requirements. See FIR and CIR Phase I SDPs.
Payload Monitoring and Detection Requirements	3.10.2		C	C	Information	
Smoke Detection	3.10.2.1		Heading	Heading	Heading	
Smoke Detector	3.10.2.1.1a-b		NA	NA	C	The integrated racks each have a smoke detector which is the approved detector and vendor (Boeing) .The interface is per the requirements. See drawings.
Forced Air Circulation Indication	3.10.2.1.2		C	C	C	The integrated racks provide a signal and data indicating that the air is flowing within the specified ranges. See ATCU table top information.
Fire Detection Indicator	3.10.2.1.3a-b		C	C	C	The Fire Detection Indicator is part of the RMS on the front of each rack. See drawings.
Parameter Monitoring	3.10.2.2		Heading	Heading	Heading	
Parameter Monitoring Use	3.10.2.2.1		NA	NA	NA	
Parameter Monitoring Response	3.10.2.2.2		NA	NA	NA	
Parameter Monitoring in Subrack	3.10.2.2.2.1		NA	NA	NA	
Parametric Monitoring in Integrated Rack	3.10.2.2.2a-b		NA	NA	NA	
Fire Suppression	3.10.3		C	C	C	Fire suppression capability exists in each rack as provided by the PFE and the access hole at the top of the rack for the PFE. See FIR asnd CIR Phase I SDPs.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Portable Fire Extinguisher	3.10.3.1a		C	C	C	Integrated racks comply with a standard door containing these access ports. See Door table top information.
Fire Suppression Access Port Accessibility	3.10.3.2		C	C	C	The door access port complies with this requirement. See Door table top information.
Fire Suppressant Distribution	3.10.3.3		C	C	C	The internal layout of the racks have been accessed and meet the requirement for suppressant distribution. See FIR and CIR phase I SDPs or ATCU table top review information.
Deleted	3.10.3.4		NA	NA	NA	
Labeling	3.10.4a-b		C	C	C	The area for the decal is availible for addition. See door layout drawings.
Materials and Parts Interface Requirements	3.11	3.3.1	Heading	Heading	Heading	
Materials and Parts Use and Selection	3.11.1	3.3.1.1	C	C	C	MIULsand MUAs have been started and materials assessements are being conducted. See delivered MIULs. See table top information for component specifics.
Commercial Parts	3.11.1.1	3.3.1.1	C	C	C	MUAs are being generated for COTS and they are being evaluated for compliance with materials requirements.
Fluids	3.11.2a-c		C	C	C	Fluids loaded into the WTCS are purchased from the same source as ISS cooling fluids (GFE). No other CIR, FIR or SAR fluids recirculation interface with the ISS. The system will be cleaned per the requirments. For N2 the system will be cleaned per the requirements.
Cleanliness	3.11.3	3.3.4.2	C	C	C	Integrated racks will meet the requirement by cleaning before assembly and keeping the assemblies clean. See contamination control plan delivered for PDR (FCF-PLN-0056). Cleaning of the racks will also be done per that document.
Fungus Resistant Material	3.11.4		C	C	C	Fungus resistant material is being used in accordance with requirements. MIULs will contain all materials used.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Human Factors Interface Requirements	3.12	3.2.4.5	Heading	Heading	Heading	
		3.3.7	C	C	C	
Strength Requirements	3.12.1a-b	3.3.7.1	C	C	C	Current bread board hardware has been evaluated for these requirements and are acceptable. These requirements are stated in the B specifications.
Body Envelope and Reach Accessibility	3.12.2	3.3.7.1	Heading	Heading	Heading	
Adequate Clearance	3.12.2.1		C	C	C	Previous crew reviews have provided the opportunity to assess this in the CIR design. Crew reviews are planned to assess this in new designs as hardware is availible. This has been assessed on drawings. See drawings.
Accessibility	3.12.2.2		C	C	C	Previous crew reviews have provided the opportunity to assess this in the CIR design. Crew reviews are planned to assess this in new designs as hardware is availible. This has been assessed on drawings. See drawings.
Full Size Range Accommodation	3.12.2.3		C	C	C	Previous crew reviews have provided the opportunity to assess this in the CIR design. Crew reviews are planned to assess this in new designs as hardware is availible. This has been assessed on drawings. See drawings.
Habitability	3.12.3	3.3.7.1	Heading	Heading	Heading	
Housekeeping	3.12.3.1	3.3.7.2	Heading	Heading	Heading	
Closures and Covers	3.12.3.1.1		C	C	C	Areas not designed for routine cleaning will have covers. See table top review information.
Built-In Control	3.12.3.1.2a-b		C	C	C	For CIR clean up of the inside of the chamber is provided by recirculation and evacuation. For FIR and SAR the clean up of specific fluids and particulates is the responsibility of the payload.
Deleted	3.12.3.1.3		NA	NA	NA	
Deleted	3.12.3.1.4		NA	NA	NA	
One-Handed Operation	3.12.3.1.5		NA	NA	NA	

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Touch Temperature	3.12.3.2	3.3.7.3	Heading	Heading	Heading	
Continuous/Incidental Contact – High Temperature	3.12.3.2.1		C	C	C	All surfaces above 49 degrees C will be protected from the crew, all equipment is located inside the rack behind doors. No surfaces have been identified as being over this temperature. See table top information.
Continuous/Incidental Contact – Low Temperature	3.12.3.2.2		C	C	C	All surfaces below 18 degrees C will be protected from the crew, all equipment is located inside the rack behind doors. No surfaces have been identified as being below this temperature. See table top information.
Acoustic Requirements	3.12.3.3	3.3.7.3	C	C	C	See acoustic noise control plan FCF-PLN-0023
Continuous Noise Limits	3.12.3.3.1a		NA	NA	NA	
	3.12.3.3.1b		C	C	C	See acoustic noise control plan FCF-PLN-0023
	3.12.3.3.1c		NA	NA	NA	
Intermittent Noise Limits	3.12.3.3.2		C	C	C	See acoustic noise control plan FCF-PLN-0023
Lighting Design	3.12.3.4a	3.3.7.1	C	C	C	Integrated racks use the paints listed for surface specularity and black anodizing with the correct surface to meet this requirement. This is needed for science requirements as well.
	3.12.3.4b		NA	NA	NA	
	3.12.3.4c		NA	NA	NA	
	3.12.3.4d		NA	NA	NA	
	3.12.3.4e		C	C	C	Use of the PUL is not precluded.
Structural/Mechanical Interfaces	3.12.4		Heading	Heading	Heading	
Deleted	3.12.4.1		NA	NA	NA	
Deleted	3.12.4.1.1		NA	NA	NA	
Payload Hardware Mounting	3.12.4.2	3.3.7.1	Heading	Heading	Heading	
Equipment Mounting	3.12.4.2.1		C	C	C	All equipment is planned to be labeled.
Drawers and Hinged panels	3.12.4.2.2		C	C	C	ORUs which must be checked routinely are mounted on drawers or hinged panels.
Deleted	3.12.4.2.3		NA	NA	NA	

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Deleted	3.12.4.2.4		NA	NA	NA	
Alignment	3.12.4.2.5		C	C	C	Guide pins are provided for all hardware with blind mate. See table top review information and drawings.
Deleted	3.12.4.2.5.1		NA	NA	NA	
Slide-Out Stops	3.12.4.2.6		C	C	C	Limit stops have been provided for all hardware which is pulled out (eg. optics bench). See table top information and drawings.
Push-Pull Forces	3.12.4.2.7		C	C	C	Push/pull force will be evaluated on hardware as it becomes availible. Bread boards have been evaluated. Some items have been evaluated by the crew.
Access	3.12.4.2.8		C	C	C	Hardware which must be accessed on a daily or weekly bases will not require removal of other hardware to be accessed.Some items have been evaluated by the crew. This does not include sliding out of the optic bench or opening rack doors.
Covers	3.12.4.2.8.1		C	C	C	See table top information and drawings.
Self-Supporting Covers	3.12.4.2.8.2		C	C	C	The only cover (the chamber door) that is not completely removable is self supporting in the open position. See table top information.
Deleted	3.12.4.2.8.3		NA	NA	NA	
Unique Tools	3.12.4.2.8.4		C	C	C	No unique tools have been identified. Design has been done using standard tool kit.
Connectors	3.12.4.3	3.3.7.1	Heading	Heading	Heading	
One-Handed Operation	3.12.4.3.1		C	C	C	ORU connectors are designed to use either hand. See table top information and drawings.
Accessibility	3.12.4.3.2a-b		C	C	C	For nominal and maintenance it is possible to mate/demate individual connectors without removing connectors or other ORUs. See table top information and drawing

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Ease of Disconnect	3.12.4.3.3a-b		C	C	C	Electrical connectors used during nominal ops require no more than two turns to disconnect and no more than 6 turns for ORU replacement.See table top information and drawings. The EPCU is the only exception.
Indication of Pressure/Flow	3.12.4.3.4		C	C	C	All fluid connectors are QD type. See table top information and drawings. FOMA bottle QDs and Filter Cartiridge QDs have indicators also.
Self Locking	3.12.4.3.5		C	C	C	All electrical connectors are self locking type. See drawings which call out connector specifications.
Connector Arrangement	3.12.4.3.6a-b		C	C	C	Connector arrangement meets the spacing requirmenents. See table top information and drawings.
Arc Containment	3.12.4.3.7		C	C	C	Electrical connector plugs are designed to isolate electrical arcs. See table top information and drawings. See drawings which call out connector specifications.
Connector Protection	3.12.4.3.8		C	C	C	Electrical connectors will have covers for protection when demated beyond temporary diconnection (maintenance/replacement).
Connector Shape	3.12.4.3.9		C	C	C	Data and power connectors differ in type to prevent mismate. See drawings.
Fluid and Gas Line Connectors	3.12.4.3.10	3.3.11.6	C	C	C	Fluid and gas connectors are located so that they can be inspected for leakage.
Alignment Marks and Guide Pins	3.12.4.3.11		C	C	C	Alignment marks or guide pins are designed into the hardware for mate.
Coding	3.12.4.3.12 a		C	C	C	Both halves of mating connectors have a unique identifier to that connection.
	3.12.4.3.12 b		C	C	C	Labels are visible when connected or disconnected.
Pin Identification	3.12.4.3.13		C	C	C	Pins in electrical plugs and recepticals are uniquely identifiable and at least every 10th one labeled.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Orientation	3.12.4.3.14		C	C	C	Grouped plugs and recepticles are oriented so that alignment methods ar in the same relative position. See table top information and drawings
Hose/Cable Restraints	3.12.4.3.15 a-d		C	C	C	The integrated rack provides a means to restrain the loose ends of hoses and cables.
Fasteners	3.12.4.4		Heading	Heading	Heading	
Non-Threaded Fasteners Status Indication	3.12.4.4.1		C	C	C	Non-threaded fasteners have indication of correct engagement.
Mounting Bolt/Fastener Spacing	3.12.4.4.2		NC	C	C	Fasteners have required clearance to permit engagement. FOMA contains several fasteners which currently do not comply. See table top information and drawings
Deleted	3.12.4.4.3		NA	NA	NA	
Multiple Fasteners	3.12.4.4.4		C	C	C	When several fasteners are used on one itme they are of identical type. See table top information and drawings
Captive Fasteners	3.12.4.4.5		C	C	C	All fasteners that are planned to be installed/ removed on orbit are captive.
Quick Release Fasteners	3.12.4.4.6a-b		C	C	C	Quick release type fasteners require one complete turn to operate and have positive locking in open and closed positions. See table top information and drawings
Threaded Fasteners	3.12.4.4.7		C	C	C	Only right handed threads are used for threaded fasteners. See drawings.
Over Center Latches	3.12.4.4.8a-c		C	C	C	Over center latches have been designed to meet the requirements. See drawings.
Winghead Fasteners	3.12.4.4.9		C	C	C	Winghead fasteners have been designed to fold down flush with surfaces.See drawings.
Deleted	3.12.4.4.10		NA	NA	NA	
Fastener Head Type	3.12.4.4.11 a-c		C	C	C	Hex type internal and external grip head fasteners have been used where on-orbit crew actuation is planned. Flush or oval internal hex grip fasteners are used were smooth surfaces are required. Torques are used in some aplications and are availible in tool kit. See table top information and drawings

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
One-Handed Actuation	3.12.4.4.12		C	C	C	Fasteners have been designed for one handed mate/demate
Deleted	3.12.4.4.13		NA	NA	NA	
Access Holes	3.12.4.4.14		C	C	C	Covers or shields through which mounting fasterners must pass for attachement have been designed for passage without percise alignment.
Controls and Displays	3.12.5	3.3.7.1	Heading	Heading	Heading	
Controls Spacing Design Requirements	3.12.5.1		NC	C	C	All spacing between controls and obstructions meet the minimum requirments. See table top information and drawings. One possible exception is the thumb switch on the FOMA timers. This meets the intent of the requirement. This will be evaluated by the crew in February.
Accidental Actuation	3.12.5.2		NA	NA	NA	
Protective Methods	3.12.5.2.1a-g		C	C	C	Protective methods in compliance with the requirements have been provided for the controls to prevent accedental actuation.See table top information and drawings
Noninterference	3.12.5.2.2		NA	NA	NA	
Dead-Man Controls	3.12.5.2.3		NA	NA	NA	
Barrier Guards	3.12.5.2.4		NA	NA	NA	
Recessed Switch Protection	3.12.5.2.5		NA	NA	NA	
Deleted	3.12.5.2.6		NA	NA	NA	
Position Indication	3.12.5.2.7		C	C	C	Switch covers currently not identified in design.
Hidden Controls	3.12.5.2.8		NA	NA	NA	
Hand Controllers	3.12.5.2.9		NA	NA	NA	
Valve Controls	3.12.5.3a-e		C	C	C	Valves have been designed for the torque values. See table top information and drawings.
Toggle Switches	3.12.5.4		NA	NA	NA	
Restraints and Mobility Aids	3.12.6	3.3.7.1	C	C	C	Use of standard crew restraints, mobility aids and interfaces have not been precluded.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Stowage Drawer Contents Restraints (Not Used by CIR)	3.12.6.1		NA	NA	NA	
Stowage and Equipment Drawers/Trays (Not Used by CIR)	3.12.6.2		NA	NA	NA	
Captive Parts	3.12.6.3		C	C	C	Equipment is designed to ensure unrestrained parts which can be removed on orbit will be tethered or held captive.See drawings.
Handle and Grasp Area Design Requirements	3.12.6.4		Heading	Heading	Heading	
Handles and Restraints	3.12.6.4.1		C	C	C	All removable items which cannot be grasped with one hand have been provided handles other means of grasping.See drawings.
Deleted	3.12.6.4.2		NA	NA	NA	
Handle Location/Front Access	3.12.6.4.3		C	C	C	Handles and graps areas are placed on the accessible surface of the items consistant with the removal direction.See drawings.
Handle Dimensions	3.12.6.4.4		C	C	C	Handles meet the minimum applicable dimensions.
Non-Fixed Handles Design Requirements	3.12.6.4.5a-c		C	C	C	Non-fixed handles have a stop position for holding perpendicular to the mounting surface, are capable of being placed in use position by one hand and removable handles have visual and/or tactal indication of locked/unlocked status.See drawings.
Identification Labeling	3.12.7	3.3.3.2	C	C	C	All items in the CIR, FIR and SAR which can be separate will be labled. See drawings.
Color	3.12.8	3.3.3.3	C	C	C	Internal collors are in accordance with the requirements. See drawings.
Crew Safety	3.12.9	3.2.4.5	Heading	Heading	Heading	
		3.3.7.3	C	C	C	
Electrical Hazards	3.12.9.1a-e		C	C	C	Electrical equipment will incorporate the controls necessary to prevent shock. See CIR and FIR phase I safety data packages.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Mismatched	3.12.9.1.1		C	C	C	A preliminary analysis has been conducted to demostrate that mismatch of the power connectors does not create a hazard and that mismate of the data connectors does not create a hazard. Data and power are different types and cannot be mismatched.
Deleted	3.12.9.1.2		NA	NA	NA	
Deleted	3.12.9.1.3		NA	NA	NA	
Overload Protection	3.12.9.1.4		Heading	Heading	Heading	
Device Accessibility	3.12.9.1.4.1		C	C	C	Overload protection devices are located in the EPCU (GFE). Other items are not on orbit replaceable.
Extractor-Type Fuse Holder	3.12.9.1.4.2		NA	NA	NA	
Overload Protection Location	3.12.9.1.4.3		C	C	C	No fuses or circuit breakers are intended to be replaced or manually reset on orbit.
Overload Protection Identification	3.12.9.1.4.4		C	C	C	No fuses or circuit breakers are intended to be replaced or manually reset on orbit.
Automatic Restart protection	3.12.9.1.4.5		C	C	C	Automatic restart is prevented after an overload condition is cleared.The EPCU meets this requirement.
Deleted	3.12.9.1.5		NA	NA	NA	
Sharp Edges and Corners	3.12.9.2		C	C	C	Sharp edges and corners will be removed. See drawings. Inspection will be performed.
Holes	3.12.9.3		C	C	C	Required round or slotted holes will be covered. See drawings.
Latches	3.12.9.4		C	C	C	Latches are designed to prevent entrapment of appendages.
Screws and Bolts	3.12.9.5		C	C	C	Threaded ends of screws and bolts are capped if they extend beyond 3.0 mm. Assembly procedures will be created.
Securing Pins	3.12.9.6		C	C	C	Securing pins are designed to prevent inadvertent back out.
Levers, Cranks, Hooks, and Controls	3.12.9.7		C	C	C	Levers, cranks, hooks and controls are located to prevent pinching, snagging, or cutting crew.

Paragraph Name	Derived Document Paragraph No.	FCF-SPEC-0001 Paragraph No.	CIR	FIR	SAR	Compliance information
Burrs	3.12.9.8		C	C	C	Burrs will be removed from all exposed surfaces. See drawings.
Locking Wires	3.12.9.9a-b		C	C	C	Safety wires will not be used on items which on orbit removal/remplacement is envisioned.Fracture critical fasteners unfastened on orbit are designed to be safety cabled or cotter pinned. See drawings.
Audio Devices (Displays)	3.12.9.10a		C	C	C	No audio devices currently exist.
Deleted	3.12.9.10b		NA	NA	NA	
	3.12.9.10c		NA	NA	NA	
	3.12.9.10d		NA	NA	NA	
Deleted	3.12.9.11		NA	NA	NA	
Egress	3.12.9.12		C	C	C	Payload egress requirements are being assessed.
Payload In-Flight Maintenance	3.12.10		C	C	C	The intgrated racks and assemblies are designed to be maintainable using standard ISS tools.
Deleted	3.12.11		NA	NA	NA	

4.0 NOTES

N/A

APPENDIX A ACRONYMS AND ABBREVIATIONS

A.1 Scope.

This appendix lists the acronyms and abbreviations used in this document.

A.2 List of acronyms and abbreviations.

CIR	Combustion Integrated Rack
DOORS	Dynamic Object Oriented Requirements System
ECS	Environmental Control System
EDU	Engineering Development Unit
EWT	Embedded Web Technology
FIR	Fluids Integrated Rack
FCF	Fluids and Combustion Facility
GIU	Ground Integration Unit
GRC	Glenn Research Center
GSE	Ground Support Equipment
ICD	Interface Control Document
IDD	Interface Definition Document
ISS	International Space Station
ITA	Interface Technical Agreement
MSD	Microgravity Science Division
NA	Not Applicable
NASA	National Aeronautics and Space Administration
PDR	Preliminary Design Review
PI	Principal Investigator
TBD	To Be Determined
TSC	Telescience Center